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Creating Shared Value and Strategic Corporate Social Responsibility through Outsourcing within Supply Chain Management

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Abstract: One way to develop local clusters is to strengthen those clusters by using outsourcing to conduct strategic social responsibility, or in other words, to create shared value, which is a win-win strategy for the buyer, supplier, and society and the best and most viable alternative to traditional corporate social responsibilities. In the leading research, a model for decision-making within the supply chain has been developed for purchasing based on shared value creation, long-term relationship management, and purchasing strategies. The research consists of two strategic mathematical models, using goal programming, and then is solved by a meta-heuristic algorithm. Potential outsourcing companies are assessed and then clustered according to their geographic locations in the decision-making process. One (or several) cluster(s) was selected among clusters based on knowledge and relationship criteria. Besides, in the primary mathematical model, the orders in different periods and the selection of suppliers are determined. In this model, in addition to optimizing the cost, the dispersion of purchases from suppliers is maximized to increase relationships and strengthen all members of the cluster. Maximizing the distribution by converting a secondary objective function to goal-programming variables transforms the multi-objective model into a single-objective model. In addition to economic benefits for buyers and suppliers, this purchasing plan concentrates on strengthening the local industrial cluster, fostering employment and ease of recruitment for human resources, accessing more infrastructures and technical support facilities, developing an education system in the region, and assisting knowledge-based enterprises with development.

Keywords: creating shared value; strategic social responsibility; supply chain management; outsourcing; meta-heuristic

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1. Introduction

In the past, suppliers, manufacturers, and distributors worked separately and distributed in their way [1]. Producers looked to suppliers as a rival [2], and they feared the benefits of suppliers because of their ties to other producers [3]. In this regard, the supply chain and issues such as shopping cart selection can play a key role in creating a competitive advantage for companies [4]. The emergence of new and healthier perspectives, such as corporate social responsibility (CSR), sustainability, and shared value creation, or strategic types of CSR [5,6], as well as resilience, has been of great interest to researchers in the supply chain and purchasing issues in recent years [7,8].

Today, companies have found that their purchasing sector can be increasingly productive [9] in improving their efficiency and effectiveness [10,11]. Companies need to work

with different suppliers [12] to continue their activities strategically. In this regard, every strategic purchase requires a strategic purchasing plan [13] for the intended product, which means a strategic relationship with the suppliers [14]. It is evident that to accomplish this, it is necessary to establish strategic relationships with well-qualified and selected suppliers [15] to achieve competitive advantages alongside strategic partnerships [15].

More attention has been paid to cost issues and product quality [16]. If organizations concentrate on supplier selection and purchasing strategies based on cost minimization [17], they will lose long-standing opportunities [18] for effective communication with society, and they may lose their competitive advantages [9,19]. In general, it can be said that adopting purchasing strategies that pursue other aims along with cost reductions can have an active role in long-term [20] and multi-aspect communication with suppliers [21] and especially provide a new opportunity to address social issues to create novel competitive advantages [19,22].

In recent years, impact investors' attention to social and environmental issues has been very important. As Figure 1 shows, these investments have been made in various sectors. On the other hand, this investment can develop local clusters through fair sourcing. According to the Global Impact Investing Network (GIIN), the effects of such sourcing are specified in the highlighted categories of Figure 1 and are extremely in line with creating shared value [23].

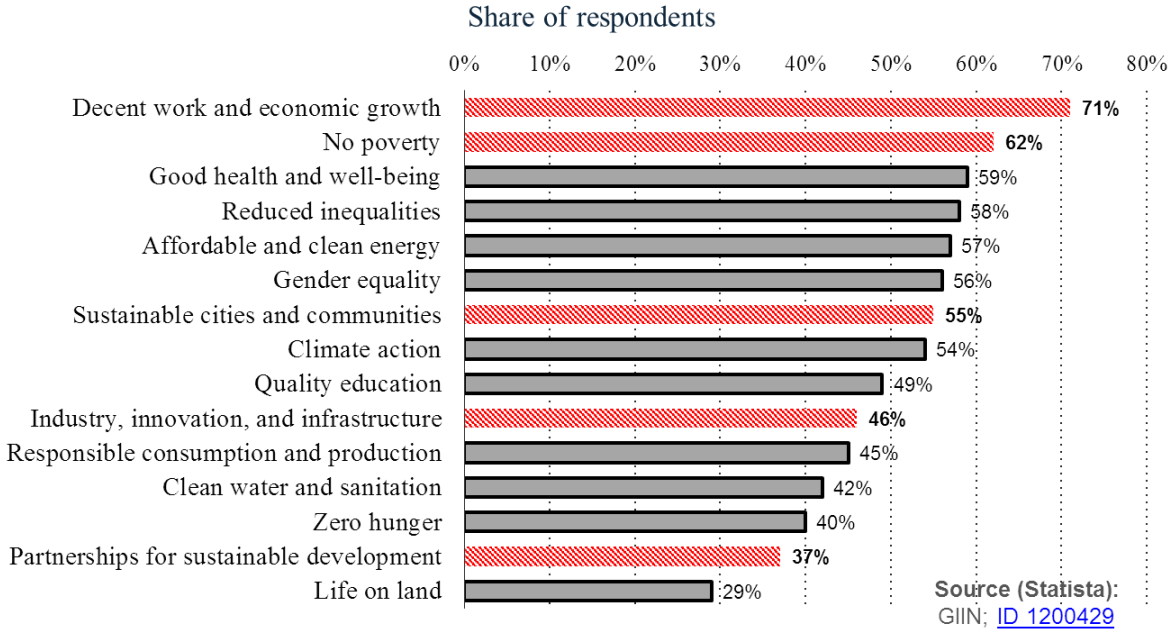

Figure 1. Sustainable development goal (SDG) themes targeted by impact investors worldwide in 2020, according to GIIN (accessed on 10 December 2021).

Creating shared value requires an advanced method [24] to address social issues [23] while simultaneously creating a competitive economic advantage [25]. Shared value is a concept in which companies can achieve this superior competitive position by either developing services and products [26] for unserved needs or through local investments [27] and cluster development [27–29] or developments in the supply chain [30,31].

This competitive argument is inherently accompanied by the objective of solving societal challenges [32] with business means to regain legitimacy for business [27,33]. A shared value perspective also concentrates on improving growing techniques and consolidating the local cluster [29,34,35] of supporting suppliers and other network members [36].

Various companies present themselves as being committed to promoting the local economy [37] and social development and the welfare of the community [38] residents, utilizing financial donations, enhancing local employment [39], supporting local purchasing, and financing for local community development and public welfare projects [40]. All

companies depend on external parties, such as suppliers, service firms, and infrastructure providers [24].

In this regard, a firm's productivity and ability to create shared value may be strongly affected by clusters [26,41], which indicate a geographic concentration [41,42] of companies with related businesses and different institutions in a given field [24]. Contributing to the development of such clusters is an excellent opportunity for creating shared value [43], but it may require substantial innovation activity [36]. Product innovation or business model innovation may be insufficient since clusters' development calls for management innovation and organization innovation [24].

Not only does Iran suffer from unfair distribution and wealth, but there is no strong will at the level of the Government and Islamic Parliament to deal with such a crisis in the current capitalistic system [44,45]. In this kind of atmosphere, the potential ecosystem is appropriately provided to pay attention to strategic forms of CSR [44] and invest to solve social challenges. Among the challenges outlined in Figure 1 are poverty, unemployment problems, and sustainable societies. Figure 2 shows the extent to which the provinces of Iran are involved in poverty and unemployment. This research aims to create a model to address these challenges, although it should not be overlooked that the existing infrastructure in these geographical areas is crucial. Some provinces (such as Sistan and Baluchestan) suffer from extreme poverty and unemployment, but on the other hand, there is no infrastructure to outsource products to companies in this province.

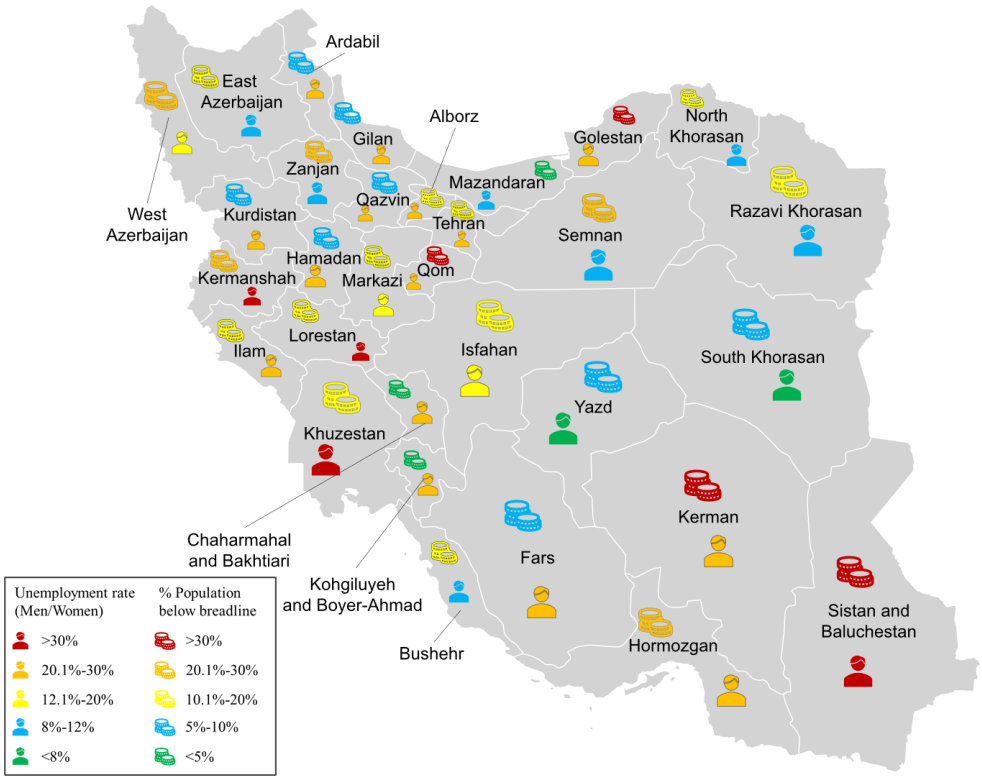

Figure 2. Poverty and the unemployment rate of Iran's provinces, according to the Statistical Centre of Iran (2018) and The Research Center of Islamic Legislative Assembly (2020).

Given that many companies in Iran have resorted to social responsibility fraud, large holdings and leading companies are looking for a way to convince public opinion of their legitimacy, and the main motivation of this research is to meet such a need. When a company in Iran can solve a social challenge, government and public attention are drawn to that company, and new opportunities are provided. For example, Danette Company in Tehran Province has taken positive measures to improve the life of the workforce and make its processes healthier. In this regard, the National Standard Organization of Iran has

allowed Danette to surpass its competitors. On the other hand, companies that went against creating common value have been marginalized by both social media and the government. The main target of this research model is the strengthening of potential clusters with available infrastructures for outsourcing to diminish social challenges. Moreover, this research aims to design a strategic model for selecting suppliers in several stages. The model under study should be designed to develop local industrial clusters. We also need to look at the company's internal stakeholders and the relationship among suppliers and the buyer so that the interests of the various stakeholders are appropriately met.

The rest of the paper is organized as follows. Section 2 reviews the research background and illustrates the previous efforts. In Section 3, the mathematical models are presented, and the model's materials are clarified. Section 4 shows the results of a real case by the methodology developed, which was used in the case of the pharmaceutical industry in Iran. Finally, in Section 5, we conclude the paper with a summary and discuss future work.

2. Literature Review

The historical evolution of suppliers' developments has been examined, and we must look at the supplier-oriented views affected by the strategies. First, Spekman [21], professor of marketing at the University of Southern California, criticized the non-strategic look at the supplier's choice in his research.

Based on our strategic views and our focus on social issues in this study, the view of creating shared value became the basis of this research. In previous studies, little effort had been made in this area; therefore, the closest efforts have been assumed in this section, which collectively forms the anatomy of the developed conceptual model of the present study. Before reviewing articles related to these topics, we have briefly reviewed the published articles regarding supplier selection.

For this purpose, we have extracted the summary of all related journal articles published from 2010 to 2020 from the Scopus database. This was carried out with the "Supplier Selection" keyword, and we did not include conference papers and book chapters in the review. A total of 2877 abstracts were extracted. We then put the abstracts of the articles related to each year in a separate file and analyzed the resulting files with Voyant Tools software using the Mandala tool. As illustrated in Figure 3, Mandala output is a conceptual visualization that shows the relationships between terms and documents. Each search term (or magnet) pulls documents toward it based on the term's relative frequency in the corpus [46,47].

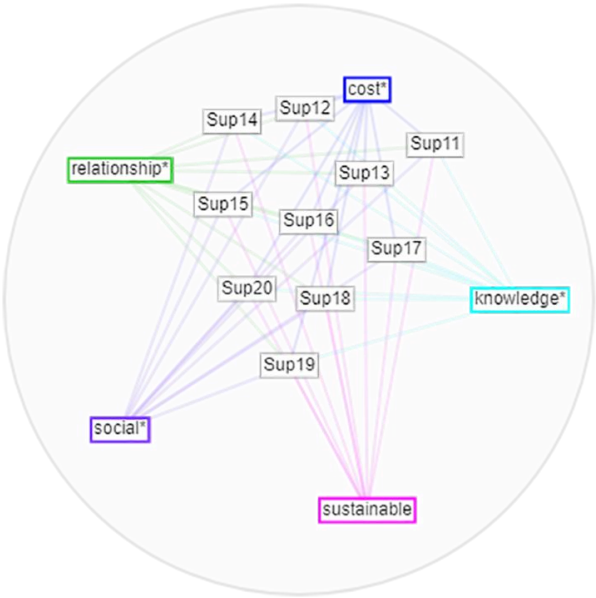

Figure 3. Mandala analysis on ten years of recent corpus extracted on the subject of supplier selection.

The Mandala analyses were carried out with five keywords related to this research: cost (optimization of purchase and order cost), relationship (long-term relationship with the supplier), knowledge (supplier selection based on knowledge criteria and knowledge sharing), sustainability, and social (attention to creating shared value and sustainability of supplier network). Mandala's output showed us that research over the past three years was closer to sustainability and social issues; therefore, this analysis demonstrates the need to move toward the social direction. Accordingly, the research from the 4 years of 2011 to 2014 is closer to cost issues. In the following, we will examine the research close to the present article's general areas: creating shared value and strategic corporate social responsibility through the supply chain.

Corporate Social Responsibility (CSR) and Creating Shared Value (CSV)

The research performed by Zhang et al. [48] aimed to clarify the impact of supplier development experiences on supply chain social responsibility. The investigation used a qualitative case study approach and empirically explored how to develop supplier CSR abilities in a pharmaceutical supply chain. Xu et al. [49] focused on a supplier selection problem regarding CSR. Notably, seven criteria and their corresponding significance for supplier selection were analyzed. Meanwhile, some related sub-criteria were covered as well. Based on the current literature review and managerial interviews acquired from leaders in the southern area of India, these problems were compared and ranked. Finally, the research concluded with a presentation of the rankings and priorities of the proposed seven criteria. Given the acquired consequences and recommendations, it would be beneficial to set up a useful approach for selecting the exceptional supplier based on CSR.

Given the vagueness of experts' opinions and the complicated interrelationships amongst evaluation criteria, Chen et al. [50] proposed and illustrated a hybrid model that combines total interpretive structural modeling (TISM) and fuzzy analytic network process (FANP) to decide the most splendid supplier from a social responsibility perspective. Yadlapalli et al. [51] addressed how social responsibility can be carried out at the manufacturing facilities in global supply chains. The research conceptualized supplier selection and supplier development as the governance mechanisms of social responsibility. The consequences disclose that supplier selection and supplier-development governance mechanisms positively impact a firm's social and environmental performance.

Govindan et al. [52] proposed a model to select the best supplier based on their corporate social responsibility (CSR) practices and to discover the key actors (shareholder, governments, customers, and community) whose viewpoint is vital. They utilized a hybrid multi-criteria decision-making (MCDM) approach; however, the supplier selection portion depends on a transparent decision-making process considering multiple criteria. The model is presented in three phases: fuzzy Delphi, DEMATEL-ANP, and PROMETHEE.

The purpose of Mani et al. [53] was to explore the social problems pertinent to suppliers and to perceive measures and dimensions relevant to social sustainability in rising economies. Further, it explored the benefits suppliers, and buyers achieve by efficiently managing such social issues. The findings exposed that 18 validated supplier social sustainability measures were underlying five social dimensions: labor rights, safety and health, societal responsibility, diversity, and product responsibility. Girdwichai and Sriviboon [54] signified the relationship between the social sustainability of suppliers and their impact on the supplier's economic and social performance. They also focused on the supplier company's popularity and its role between sustainability and performance.

Yaghin and Sarlak [55] aimed to suggest an integrated supplier selection, order allocation, transportation planning model, and investment planning for corporate social responsibility (CSR) over a given multi-period horizon under uncertainty. Furthermore, the total market demand viewed a customer's behavior to pay extra cash for CSR attributes. Moreover, the authors observed that the social investment of the buyer, to stimulate market demand, can affect the total profit (TP) and involve the total contribution of suppliers in social responsibility.

The exploratory study performed through Fontana and Egels-Zandén [56] of 30 export-oriented and first-tier apparel suppliers in Bangladesh, a developing country, revealed the need to spread CSR homogeneously amongst suppliers and reconceptualize the meaning of CSR in developing countries, encouraging more scrutiny toward horizontal dynamics. The aim of Fontoura and Coelho [57] was to perceive the influence of the supply chain leadership (SCL) and followership (SCF) on corporate social responsibility (CSR), considering the moderator role of the supply chain leadership dependency (SCLD). Additionally, they considered the mediating effects of information sharing (IS), shared value (SV), and purchasing social responsibility (PSR), since these variables might also assist in understanding the chain of effects that leads to a sustainable supply chain. They implied that PSR and SV have a powerful influence on CSR.

Wen et al. [58] performed a bibliometric evaluation primarily based on 4687 papers on supplier management from 1997 to 2017. The outcomes demonstrated that the supplier management field has made breakthroughs in both breadth and depth. Representative themes, especially "sustainable supply chain," "corporate social responsibility," and "knowledge management," have gently penetrated the area of supplier management. Research relevant to "supplier selection" and "supplier relations" have usually been of the highest strategic importance.

Hoque and Rana [59] made two contributions in their review article. First, it synthesized buyer–supplier relationship (BSR) typologies and grouped them into nine main dimensions, namely transaction orientation, relation orientation, operational excellence, partnership form, governance pattern, information exchange mode, cooperative mindset, collaborative attitude, and strategic orientation, and demonstrates a relationship amongst the BSR dimensions, supplier's working environment, and organizational performance. Second, their findings exhibited that the working environment is essential in cross-border sourcing and supply management; however, it has been overlooked in the BSR literature from nearly every disciplinary perspective. They concluded by employing six research agendas: governance and shared value/strategic CSR, capability improvement and value appropriation, intervention and productiveness enhancement, knowledge augmentation, institutional impact, industry condition, and sustainable practices. They talked about these research agendas and illustrated a pathway to improve research on the intersection of the three issues in BSR in a cross-border context.

In previous research, there have been many discussions about "why" we pay attention to social issues and turn them into business situations. Moreover, many experts have stated theoretical solutions for it. However, in the supply chain and sourcing, so far, no research with an operational approach has looked at the social issues through the lens of strategic CSR and local clustering. Previous research has provided useful insights into sustainable and responsible purchasing. Nevertheless, the absence of a comprehensive model for creating shared value is still felt [60,61].

Moreover, a model that creates shared value and long-term buyer-supplier benefits with a rational and legitimated perspective should be designed based on Porter and Kramer's [29] discussions on the next evolution of capitalism. Our research uses the latest strategies proposed by [22,29,61] to present a mathematical model, including the sieve and selection of suppliers and order allocation. The details of the strategies for this study and how to use it in mathematical modeling are discussed in the next section.

3. Methods and Materials

Although the traditional and repetitive criteria such as cost, quality, and delivery time are considered vital criteria in most studies [62], they are not enough to build trust and commitment between the buyer and the supplier to create a long-term communication plan. In this regard, the Spekman model [21] offered two main steps for selecting suppliers: first, collecting complete information based on different criteria from current, domestic, and foreign suppliers and sieving them to create a cluster of potential suppliers for a strategic partnership; second, reviewing and analyzing the strategic partnership to select the leading partner to form a long-term relationship with (Figure 4).

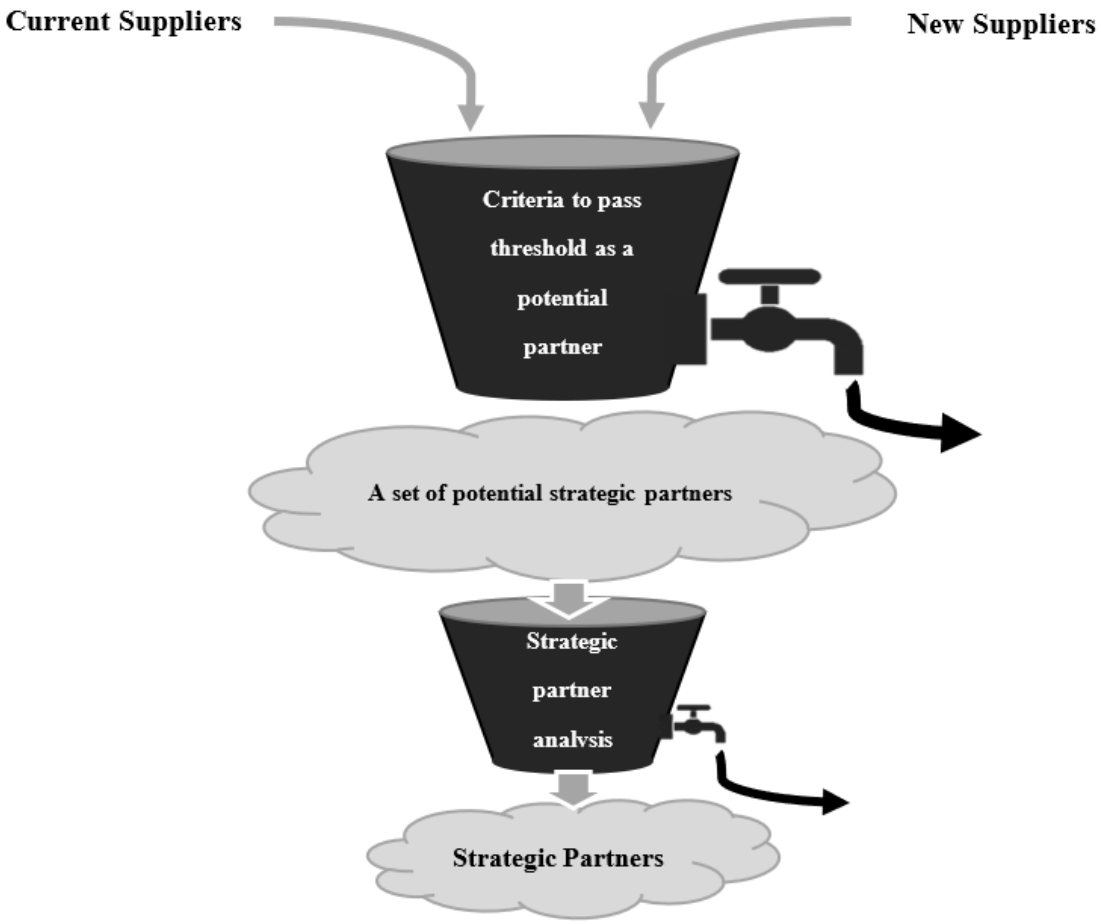

Figure 4. Selecting strategic partners.

The paper's model is developed by reviewing and using the "Updater" strategy in the Lindgreen et al. [63] paper. Before we go into mathematical models and explanations of this section, we briefly review the strategies outlined in the mentioned article. By and large, they claim their research purpose as follows: first, explore the purchasing strategies of the company in the field of supply relations, besides finding which strategy differs according to the complexities of the buyer-supplier relationship with the company's buying goals. Besides, they categorized the strategies into two dimensions. The first dimension is the complexity of relationships interconnected in three parts of the transactional exchange, relational partnership, and network collaboration and then from the viewpoint of the purchase target, which is divided into two parts: purchasing effectiveness and purchasing efficiency. The main strategies proposed in this study are shown in Table 1.

Table 1. Purchasing strategies. Adapted with permission from ref [63]. 2009, Senja Svahn and Mika Westerlund.

		Goals and Targets of the Purchasing	
		Efficiency	**Effectiveness**
Relationship Complexity between Buyer and Supplier	Transactional Exchange Relational Partnership Collaboration Network	Price Minimization Bargaining Clockwise	Adaptor Projector Updater

Each strategy refers to specific cases; refer to the reference article for more information. The most elaborated strategy is the "Updater" strategy, which deals with the effects of the buying strategy in a long-term relationship. This strategy is based on continuous collabo-

ration and networking in research and development projects. The nature of "Updater" is a network rather than a bilateral relationship. This kind of partner collaboration leads to more adaptation and open knowledge sharing.

Shared Value Network Creation

Before explaining the model, a fundamental question needs to be answered. Why and how is shared value creation used in this research? One strategic alternative to social responsibility that leads to shared value creation is developing local industrial clusters and strengthening their members by outsourcing or purchasing products and services. By enabling local cluster development (supporting other companies, local organizations, infrastructure, and academic programs), companies can strengthen local capabilities and assets [64].

Nowadays, establishing the advent of industrial clusters in outsourcing and purchasing is one of the most potent ways to create shared value. The employer of this research is the largest pharmaceutical holding company in Iran, and if it selects suppliers of industrial clusters for its products, the result is a flourishing in production and the inflow of a large amount of money into the area where the cluster is located.

Over time, if long-term relationships are established with these suppliers, the mentioned cluster will develop in many ways, such as education, transportation, product development, and innovation. What increases desirability is the company's lack of need for unrelated costs in traditional social responsibility activities, the non-strategic form (outside of shared value and strategic social responsibilities) leading the company to non-core missions and non-strategic activities. Therefore, based on Porter and Kramer [29] and strategic corporate social responsibility [65], this research develops industrial clusters through outsourcing and purchasing. Based on the views present in this study, the stages of formation to problem-solving can be defined as follows:

Phase 1: Supplier clustering: In this phase, a large amount of information about potential suppliers is first collected, and according to experts, based on the two criteria of geographical area and suppliers' connectivity with each other, clusters are determined whose members have high communication and short geographical distance. Choosing a cluster in a geographical area with members interacting creates opportunities for suppliers and the environment differently. In practice, a network of suppliers develops many products while also providing opportunities for its geographical area to increase knowledge and employment.

Phase 2: Sieving model: The selection of one (or more) cluster is designed based on knowledge criteria and the "Updater" strategy. The model is designed to examine and select the best cluster from different aspects. The variables within this model are binary variables for choosing clusters and companies. The model can select one or more clusters and select or reject suppliers within the selected cluster. Because all suppliers in a cluster may not have the necessary conditions, it is possible to select better suppliers from the selected clusters. The main criteria of this model are generally divided into two categories: communication and knowledge. Communication variables describe how much a supplier wants to build long-term communication in the supply network. Criteria of knowledge also deal with the level of activity and scientific infrastructure of a supplier. The output of this model is one or more selected clusters within the selected suppliers with the best performance in the supply network.

Phase 3: Purchase model: The mathematical purchasing model is formed after selecting the suppliers. The required data are collected from suppliers, and the model is executed. By and large, the purchasing model seeks to determine the number of purchases and outflows in multiple periods and determines which products, from which supplier, in which period, and to what extent they should be purchased. Besides, the buying model is a multi-product model. In addition to the cost criteria, there are constraints to distribute purchases and outsourcing among different suppliers, and in a way, orders are distributed

throughout the network by considering optimism. In this model, production within the company is also considered.

Based on the supplier selection process that Spekman [21] presented and the views discussed earlier [28,29,63], we developed a three-step decision-making model (Figure 5) including two mathematical models:

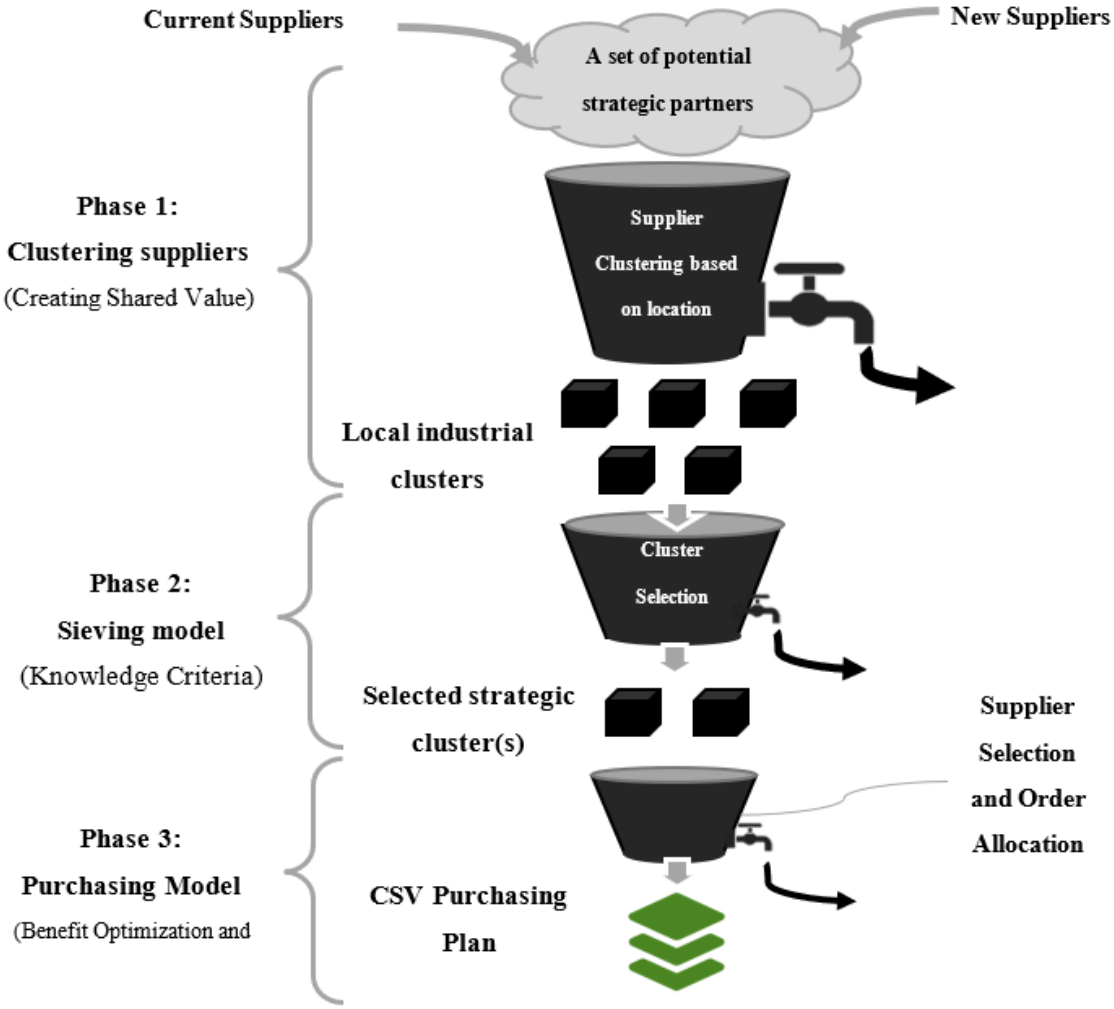

Figure 5. Conceptual model of shared value network creation.

Sieving model: In the first model, using updated criteria in the strategy and using the data collected by the suppliers, the optimal linear programming optimization model was developed to sieve the suppliers.

According to the industry and experts' opinions, criteria were selected to design a sieving model of the literature and some criteria under study. The criteria are the ease of communication index (openness) [63,66,67], index of the patents published in the last five years [68], index of the articles published in the last five years [63,66,69], index of the number of new products introduced in the last five years [1], production capacity index [63,66,69], technology level index [66], knowledge infrastructure index [63,66,69], scientific activity index [70], number of R&D employees index (added by experts), and index of R&D budget [71]. Based on these, the model was made, and after correction, it was approved by the experts. The indices, parameters, and variables of the sieving model are as follows:

Indices:

j Index of suppliers.

Parameters:

PTj The patents printed by supplier *j* in the last five years.
ARj Articles published by supplier *j* in the last five years.
OPj Openness index, information sharing rate.
WP The penalty of the minus shortage R&D personnel variable of goal programming constraint.
CPi Supplier *j* capacity.
RDi Number of R&D personnel supplier *j*.
RD′ The goal of R&D personnel of suppliers.
CP′ Minimum total capacity required by suppliers for a period.
NU Minimum number of suppliers to be selected by the model.
IFj Provider knowledge infrastructure index *j*.
ASj The amount of attendance, activity, and dynamism in scientific assemblies and festivals.
NEj The number of new products entered into the market over the past five years.
TCj Levels of technology used in production.
BGj R&D budget.

Variables:

fj Zero and one, select (one) or no selection (zero) supplier *j*.
dj The minus shortage variable of R&D personnel of goal programming constraint.

$$Max = \sum_{j=1}^{J} PT_j f_j Y_i + \sum_{j=1}^{J} AR_j f_j Y_i + \sum_{j=1}^{J} OP_j f_j Y_i + \sum_{j=1}^{J} IF_j f_j Y_i + \sum_{j=1}^{J} TC_j f_j Y_i + \sum_{j=1}^{J} AS_j f_j Y_i + \sum_{j=1}^{J} NE_j f_j Y_i + \sum_{j=1}^{J} BG_j f_j Y_i - WP_1 d_{1j}^{-} - WP_2 d_{2j}^{-} \quad (1)$$

Subject to :

$$\sum_{j=1}^{J} RD_j f_j Y_i + d_{1j}^{-} - d_{1j}^{+} = RD\prime \quad (2)$$

$$\sum_{j=1}^{J} CP_j f_j Y_i + d_{2j}^{-} - d_{2j}^{+} = CP\prime \quad (3)$$

$$\sum_{j=1}^{J} Y_i \leq NU \quad (4)$$

$$f_j, Y_i \in \{0, 1\} \quad (5)$$

$$G \times P\,D \times V : d_{2j}^{-}, d_{2j}^{+}, d_{1j}^{-}, d_{1j}^{+} \quad (6)$$

Purchasing model: In the second model, demand information, costs, and capacity of selected suppliers in the first model for purchasing are formulated using a non-linear optimal mathematical model. This model is designed considering long-term relationships with these suppliers.

The variables of the mathematical purchasing model were obtained by interviewing the company's experts. It was also revealed that the model should be designed to make a fair distribution in the periodic purchases. Consequently, the network will be better created, encouraging competitive tensions productively [72].

Accordingly, in addition to the constraints of ordering and warehousing, a separate constraint was considered (10) to distribute purchases among selected suppliers. For the model to choose among suppliers and be more flexible, goal programming variables are defined in the objective function and constraint (10). For these variables, a penalty was considered that determines the degree of flexibility of the model in the selection. The higher the fine, the lower the cost of optimization. This is an indirect cost that the decision-maker is willing to bear in the absence of contact with other suppliers, and the decision-maker

himself determines the amount. The indices, parameters, and variables of the first model are:

Indices:

t	Periods.
j	Supplier index.
i	Product index.

Parameters:

Oj	Ordering cost from supplier j.
Ki	The cost of manufacturing line set-up for the product i.
Cit	The cost of producing a unit of product i in period t.
$Pijt$	The cost of buying each product i from supplier j in period t.
Hi	Holding cost of product i.
Dit	The demand for the product i in period t.
$Lijt$	Production capacity of supplier j of product i in period t.
Ei	Firm production capacity of product i.
$SSit$	Percentage of safety stock from the product i in period t.

Variables:

Ujt	The variable of purchases of the product i from the supplier j in the period t.
Qit	The variable of the production of the product i by the buyer in period t.
Yit	The binary variable: production (one) or no production (zero) of product i in period t.
Zjt	The binary variable: purchase (one) or non-purchase (zero) of the product i from the supplier j in period t.
Iit	The inventory variable of product i in period t.
dj	Variable of goal programming constraint.

$$Min = \sum_{i=1}^{n}\sum_{t=1}^{T} K_i \times Y_{it} + \sum_{j=1}^{m}\sum_{t=1}^{T} O_j \times G_{jt} + \sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{t=1}^{T} P_{jit} \times U_{jit} \times Z_{jit} + \sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{t=1}^{T} C_{it} \times Q_{it} \times Y_{it} + \sum_{j=1}^{m} W \times d_j^- \quad (7)$$

Subject to :

$$\sum_{i=1}^{n} Z_{jit} \le n \times G_{jt} \quad for\ j = 1, 2, \ldots, M;\ t = 1, 2, \ldots, T; \quad (8)$$

$$\sum_{j=1}^{m} U_{jit} Z_{jit} + Q_{it} Y_{it} \ge D_{it}(1 + SS_{it}) \quad for\ i = 1, 2, \ldots, N;\ t = 1, 2, \ldots, T; \quad (9)$$

$$\sum_{t=1}^{T} G_{jt} + d_j^- - d_j^+ = \left[\frac{T \times n}{m}\right] \quad for\ j = 1, 2, \ldots, M;\ i = 1, 2, \ldots, N; \quad (10)$$

$$\left.\begin{array}{l} U_{jit} Z_{jit} \le L_{jit} \quad (11) \\ Q_{it} \le M_i \quad (12) \\ d_j^- \times d_j^+ = 0 \quad (13) \\ Z_{jit}, Y_{it}, G_{jt} \in \{0, 1\} \quad (14) \\ U_{jit}, Q_{it}, d_j^-, d_j^+ \in \mathbb{Z} \quad (15) \end{array}\right\} \quad for\ j = 1, 2, \ldots, M;\ i = 1, 2, \ldots, N;\ t = 1, 2, \ldots, T;$$

Although the above strategic model alienates us from the optimal cost model solution by adding a proposition to the objective function and a constraint, it also enhances our relationship with selected suppliers in the long term. The sieving model selected suppliers based on knowledge criteria, knowledge sharing, and research and development. As a result, it is expected that more knowledge sharing will occur with the strengthening of the relationship between the supplier and the buyer, and reliable planning can be carried out for this purpose.

4. Results

As explained in the previous section, the initial model was written using Porter and Kramer [28], Porter and Kramer [29], and Lindgreen et al.'s [63] strategic foundations to select an industrial cluster for long-term and effective outsourcing that brings many benefits

to buyers and suppliers, simultaneously. The consequences of applying these strategies will be discussed in detail in conclusion.

To implement the sieving model, data related to the model were collected, which are shown in Table 2. Three geographical clusters were formed based on Figure 2 and the existing infrastructure in the provinces. These three clusters, Fars, Alborz, and Markazi Provinces, had many social challenges; some of them are shown in Table 2. Since companies are mostly reluctant to share their information, obtaining some of it has not been easy. Regarding the criteria for which it was impossible to collect accurate data with the consent of the experts, we collected them based on the opinions of experts familiar with those companies. As a result, in Table 2, some criteria (openness index, knowledge infrastructure, technology level, and scientific communities) ranged from 1 to 9 are judicial data collected by experts' opinions. Also there are some related data to run a goal programming mathematical model shown in Table 3.

Table 2. Clusters' supplier data (strategic sieving).

		Printed Patents	Published Articles	Openness INDEX	R&D Personnel	Knowledge Infrastructure	Scientific Communities	New Products	Technology Levels	R&D Budget
Cluster A (Fars P.)	Company A1	2	12	8	4	1	5	10	4	120
	Company A2	1	14	4	3	2	4	6	3	230
	Company A3	2	13	5	5	3	4	11	5	300
	Company A4	4	16	5	4	5	3	6	6	250
	Company A5	3	9	2	2	3	3	7	3	190
	Company A6	7	10	4	5	2	4	10	4	200
Cluster B (Alborz P.)	Company B1	3	11	2	2	3	6	4	8	130
	Company B2	4	21	2	3	8	5	6	4	270
	Company B3	2	12	5	2	4	3	4	2	120
	Company B4	0	18	8	4	5	3	3	4	100
	Company B5	8	28	1	6	7	7	14	5	320
	Company B6	2	20	5	3	6	4	6	2	200
Cluster C (Markazi P.)	Company C1	4	32	4	5	8	9	20	6	360
	Company C2	5	18	5	2	4	6	12	7	200
	Company C3	4	13	7	2	5	5	10	8	180
	Company C4	6	12	6	3	3	3	4	6	220
	Company C5	3	11	5	4	4	3	8	7	200
	Company C6	2	16	7	4	5	2	9	4	250

Table 3. Goal programming data of cluster selection (sieving model).

	Value
Negative goal variable penalty	2
Personnel constraint goal	25
Maximum selected clusters	1

4.1. Data Normalization of the Sieving Model

Since the data collected for the objective function of the initial model are not of the same type (e.g., cost), the data should be entered into the model after normalization. Accordingly, the data were modeled using linear normalization [73] and were ready to enter scales.

$$n_{ij} = \frac{a_{ij}}{Max_i(a_{ij})} \tag{16}$$

$$n_{ij} = \frac{Min_i(a_{ij})}{a_{ij}} \tag{17}$$

$$n_{ij} = 1 - \frac{a_{ij}}{Max_i(a_{ij})} \tag{18}$$

In this method, the positive indices using Equation (16) and the negative indices using Equation (17) are scaled. If all indices are negative, Equation (18) can also scale the indices. In our model, all indices were positive, and Equation (16) were used.

The normalized data are listed in Table 4. Only the data on the number of R&D personnel need to be normalized since the planning in the model is objective, and these data are only used in constraints.

Table 4. Normalized data of the sieving model.

	Published Patents	Published Articles	Openness Index	R&D Personnel	Knowledge Infrastructure	Scientific Activities	New Products	Technology Levels	R&D Budget
Comp. A1	0.25	0.375	1	0.666667	0.125	0.555556	0.5	0.5	0.333333
Comp. A2	0.125	0.4375	0.5	0.5	0.25	0.444444	0.3	0.375	0.638889
Comp. A3	0.25	0.40625	0.625	0.833333	0.375	0.444444	0.55	0.625	0.833333
Comp. A4	0.5	0.5	0.625	0.666667	0.625	0.333333	0.3	0.75	0.694444
Comp. A5	0.375	0.28125	0.25	0.333333	0.375	0.333333	0.35	0.375	0.527778
Comp. A6	0.875	0.3125	0.5	0.833333	0.25	0.444444	0.5	0.5	0.555556
Comp. B1	0.375	0.34375	0.25	0.333333	0.375	0.666667	0.2	1	0.361111
Comp. B2	0.5	0.65625	0.25	0.5	1	0.555556	0.3	0.5	0.75
Comp. B3	0.25	0.375	0.625	0.333333	0.5	0.333333	0.2	0.25	0.333333
Comp. B4	0	0.5625	1	0.666667	0.625	0.333333	0.15	0.5	0.277778
Comp. B5	1	0.875	0.125	1	0.875	0.777778	0.7	0.625	0.888889
Comp. B6	0.25	0.625	0.625	0.6	0.75	0.444444	0.3	0.25	0.555556
Comp. C1	0.5	1	0.5	1	1	1	1	0.75	1
Comp. C2	0.625	0.5625	0.625	0.5	0.5	0.666667	0.6	0.875	0.555556
Comp. C3	0.5	0.40625	0.875	0.5	0.625	0.555556	0.5	1	0.5
Comp. C4	0.75	0.375	0.75	0.75	0.375	0.333333	0.2	0.75	0.611111
Comp. C5	0.375	0.34375	0.625	1	0.5	0.333333	0.4	0.875	0.555556
Comp. C6	0.25	0.5	0.875	1	0.625	0.222222	0.45	0.5	0.694444

4.2. Selection of Clusters

Based on the input data in the first model (cluster selection) discussed in the previous section, the problem with the form of the sieving model presented in the previous chapter was formulated and solved in Lingo and MATLAB (genetic algorithm) software. The optimal solution obtained from both software, given the nonlinearity of the model, shows that the optimal point is the final solution. The answers are:

Based on the initial model (Table 5), cluster C (Markazi Province) is selected as the cluster at this stage, and the data of the companies in that cluster in the input data (Tables 6–8) are used to run and execute the genetic algorithm.

Table 5. Results of sieving model.

Description	Variable	Value	Description	Variable	Value	Description	Variable	Value	Description	Variable	Value
Companies of Cluster A	F1	0	Companies of Cluster B	F7	0	Companies of Cluster C *	F13	1	Cluster no.1	F19	0
	F2	0		F8	0		F14	0	Cluster no.2	F20	0
	F3	0		F9	0		F15	1	Cluster no.3	F21	1
	F4	0		F10	0		F16	1	Deviation from negative goal	F22	5
	F5	0		F11	0		F17	1	Deviation from positive goal	F23	0
	F6	0		F12	0		F18	1			

* Selected Cluster.

Table 6. The purchase price, capacity, and order cost (purchasing model).

	Com. C1	Com. C3	Com. C4	Com. C5	Com. C6
Supplement (1) unit price	16,000	15,500	15,350	15,800	16,500
Supplement (2) unit price	21,200	22,700	20,900	22,150	21,800
Supplement (3) unit price	12,900	13,250	12,250	12,750	13,500
Supplement (4) unit price	36,700	36,000	35,000	37,300	35,650
Supplement (1) capacity	1300	2470	2860	780	1560
Supplement (2) capacity	2730	2990	3900	2340	2990
Supplement (3) capacity	2080	2600	3380	2600	1950
Supplement (4) capacity	5200	4550	3900	2860	5070
Suppliers' order cost	4,400,000	5,478,000	4,840,000	5280,000	6,380,000

Table 7. Product demand *i* in period *t*.

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Supplement (1)	1200	1320	1680	2280	2040	1440	1080	960
Supplement (2)	2760	2640	2580	2520	2760	2880	2640	2400
Supplement (3)	2160	2160	2160	2160	2160	2160	2160	2160
Supplement (4)	5760	6000	6240	6600	6240	6000	5640	5400

Table 8. Inbound production data.

	Product Cost (Per Unit)	Set Up Cost	Company Capacity (Per Month)	Safety Stock % (Per Month)	Inventory Cost (Per Month)
Supplement (1)	14,000	7,200,000	1600	7	120
Supplement (2)	20,200	4,500,000	2600	7	240
Supplement (3)	11,400	6,500,000	2400	7	190
Supplement (4)	33,500	5,400,000	5600	7	300

4.3. Purchasing Model Data Collection

The purchasing model is a non-linear integer mathematical model and NP-HARD. Model decision variables are all integers and correspond to each purchase quantity variable, and there is a zero and one decision variable that indicates buy/produce or no buy/produce.

The original model had to be modified to a standard genetic form in MATLAB. These changes are: (A) all constraints are equal to zero; (B) the objective function is in the form of minimization; (C) determine the range of variables in the model; (D) determine integer variables; (E) determine the number of variables.

Moreover, given that we were dealing with a non-linear example with many variables (about 500), a variety of mutations and intersection functions had to be tested on problem solving. In this research, we have obtained different results tens of times using the final model and different functions and settings.

4.4. Genetic Algorithm Settings

Among the different settings of the genetic algorithm, some settings that give more logical answers are listed below (Table 9). The Gaussian operator for mutation was avoided because it is used in unlimited problems [74,75]. Moreover, intermediate intersection was not used for intersection operators because of its use for large-scale linear problems [76].

Among the various implementations in Table 10, the best execution of each setting is selected and presented in Appendix A. It should be noted that most of the responses of a particular type of setting were not significantly different in terms of the objective function and the values obtained. The results are presented in the tables based on the number of runs of the genetic algorithm, and the variable names are mentioned as in the model.

Table 9. Genetic algorithm settings in different implementations.

#	Crossover	Mutation	Pop-Size
1	Constraint Dependent	Constraint Dependent	10,000
2	Uniform	Constraint Dependent	5000
3	Constraint Dependent	Constraint Dependent	10,000
4	Adaptive Feasible	Two Point	10,000
5	Adaptive Feasible	Scattered	20,000
6	Constraint Dependent	Single Point	10,000
7	Constraint Dependent	Scattered	10,000

Table 10. Summary table of the objective function and goal variables.

	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7
Crossover	Constraint Dependent	Uniform	Constraint Dependent	Adaptive Feasible	Adaptive Feasible	Constraint Dependent	Constraint Dependent
Mutation	Constraint Dependent	Constraint Dependent	Heuristic	Two Point	Scattered	Single Point	Scattered
D1	1	2	3	0	0	0	3
D2	2	3	2	1	0	3	3
D3	2	0	3	2	4	0	3
D4	3	4	1	2	2	5	0
D5	0	2	1	3	4	0	2
Epochs	2334	1176	982	975	860	1248	2057
Objective Function	1.59×10^9	2.10×10^9	1.72×10^9	1.98×10^9	1.86×10^9	1.78×10^9	1.77×10^9
Outsource Lot	78,123	70,693	80,917	75,001	84,117	81,742	73,572
Inbound Lot	20,271	27,647	20,117	23,058	14,264	16,699	24,808
Total	98,394	98,340	101,034	98,059	98,381	98,441	98,380

Based on the results (Appendix A), one can analyze the model objectives outlined in Section 3. Based on these goals, the answer is that we aim to minimize the objective function while at the same time providing a diverse portfolio of suppliers that guarantee long-term, stable relationships with suppliers in outsourcing products. As shown in Table 10, in terms of the degree of the objective function, the one executed with the constraint-dependent operators provided the more desirable answer. In this respect, the three, six, and seven solutions are in the next rank in the objective function.

In cart dispersion, one, three, and four are more desirable, and the number of objective variables is closer to zero and more dispersed. Accordingly, and considering the same iterations of the answer with the same settings, it can be concluded that answers one and then three are more favorable with the dependent constraint operators (Table 10).

Moreover, in Figure 6, after normalizing the numbers, it is shown what differences among each implementation of the algorithm (due to its different settings) have been made. As illustrated, Run #6 shows a good situation in all cases, which means the more it tends to be minimum, the more efficiency is obtained. It should be noted that an index called variance has been added to the chart that shows the distribution of purchases among suppliers.

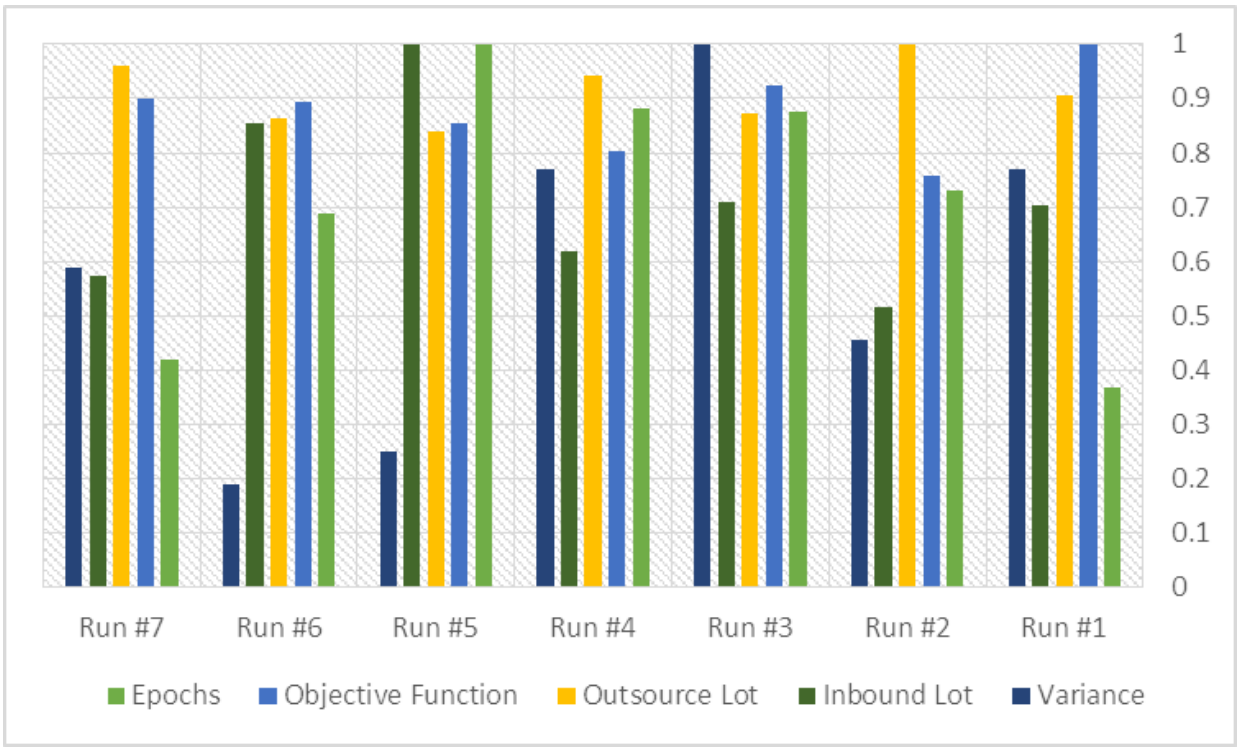

Figure 6. Performance comparison of the different settings (normalized).

4.5. Discussions and Managerial Insights

The implementation of this research showed that sourcing and outsourcing based on the creation of common value help the circulation of capital and money in deprived areas. Although known as an industrial province, Central Province in Iran has a high unemployment rate and poverty. The development of the industrial pharmacy cluster in Markazi Province and the city of Arak (with three active companies) provides many employment opportunities for this region. The existence of two universities in Arak (one medical and one engineering) can provide human resources for this opportunity.

Although these models were implemented in the Iranian pharmaceutical industry, they can expand to other industries. For example, this model can manufacture electronic components, handicrafts, and food products. The main variables of the second model are considered in general and can be implemented in any industry. Moreover, the first model can be generalized to most industries, and its unnecessary parameters can be reduced as needed. It can also be said that this method of sourcing and these mathematical models can be used for other countries and offshoring. For instance, these models can be used as a basis for selection and purchase for Fairtrade [77,78] products.

As mentioned earlier, using this method of procurement, in the long run, can bring benefits to the company and its infrastructure (consisting of the partner companies, suppliers, and service providers) and the community (consisting of employees and people). Table 11 summarizes the benefits that can be obtained.

These results were obtained using a survey session after designing the model. First, three social responsibility experts in the buyer and supplier companies were interviewed, and possible results were obtained. Then, the possible results were discussed in the presence of representatives of each field (buyer company, suppliers, customers, and ordinary people: two persons from each group). The output of the results is written based on the consensus of the related members.

Table 11. Long-term consequences based on experts' opinions.

Long-Term Consequences	Benefit Level			
	Corporate	**Suppliers**	**Employees**	**Society**
Investment focus in the industrial cluster geographic area		Low	Moderate	High
The emergence of new service and manufacturing jobs and related companies		High		High
Creating shared value and strategic CSR replaces costly social responsibility	Very High	High		
Reduce the risk of ordering	Very High	Moderate		
Easy to access and cost reduction of raw materials		High		
Strengthen knowledge sharing network	Very High	High		
Improving product quality by learning about new technologies	High	High		Moderate
Development of knowledge-based companies in the region		High		High
Development of pharmaceutical-related specialties		High		High
Focus on job search and ease of attracting human resources	Low	Very High	High	High
Empowering the people of the region and trying to eliminate unemployment			Moderate	High
Increase job security in the region and a more straightforward career path			Very High	Moderate
Development of education systems			High	Very High
Access to more support technical facilities and infrastructure	Moderate	High		

5. Conclusions

One way to develop local industrial clusters is to strengthen outsourcing influenced by a shared value creation perspective. In the above model, the companies considered for outsourcing were first classified according to their geographical location, and one (or several) cluster(s) was selected. Establishing long-term relationships with a cluster and selecting them based on knowledge criteria can benefit the buyers. If clustering had not taken place, the only choices would have been based on criteria of knowledge, and most likely, suppliers would have been selected who were not in the geographical area. Furthermore, if we did not apply the knowledge criteria according to Lindgreen et al. [63] strategies, there would be no compelling reason to establish a sustaining and lasting relationship with selected suppliers. Therefore, it can be concluded that industrial clusters (shared value creation) and purchasing strategies in supply chain management can be used as a dominant view in decision making. What increases the desirability is the company's independence in the traditional social responsibility scenes, which takes away the company to the core mission.

Strategic CSR or CSV is an improved viewpoint of CSR [65] on the business that binds social needs and challenges to its core business and eliminates the need for a company to perform activities it does not specialize in, such as traditional CSR. Moreover, according to the predictions made by Porter and researchers in this field, creating shared value will be the basis of competitive advantage in the future [25]. This research is a step forward in spreading this concept and developing a model for purchasing decision making, with long-term and thought-provoking revenues compared to previous models. The model developed in this research was implemented and solved using a genetic algorithm in MATLAB software.

The innovations in the methodology of this research can be discussed from several perspectives that can be categorized and summarized. The most important feature of this research relates to the strategic choice of suppliers. In previous studies, the strategic selection of suppliers was not made by mathematical programming through the viewpoints of strategic CSR. Most of the approaches used in these studies were ranking and scoring approaches to select the best suppliers. Strategic modeling has not been found to add a specific strategy proposed in previous research to the mathematical model of lot sizing and supplier selection, and this is an essential innovation for future research.

Besides, paying attention to shared value creation strategies in operational decision-making and mathematical models is one of the innovations of this research. Although choosing an industrial cluster may reduce some of our cost-based optimizations, implementing this plan in a system will bring many long-term benefits to the community and the company. The company's benefits include strong relationships with suppliers, rapid quality development, lower shipping costs, and better and easier knowledge transfer. Furthermore,

in previous studies, most theoretical issues have been addressed. In this study, several perspectives are combined. On the one hand, the company can produce some products. On the other hand, the company can provide some products while using high-capacity suppliers, establish long-term relationships, and then plan for innovation and knowledge sharing.

Despite the cooperation of experts, this research was limited for a couple of reasons. The most important limitation of the research was collecting data related to the criteria. Most suppliers provided opaque and inaccurate information, forcing us to rely more on experts' opinions and judgments. Future research is expected to concentrate more on the concept of shared value creation and strategic CSR. Although these concepts seem to be semantically related to traditional social responsibility, they are quite different in practice. Researchers are encouraged to discover innovative manners in creating shared value in the supply chain, in addition to fair resourcing. Among them is the evaluation of sub-suppliers. There may also be other manners to create shared value in different industries; therefore, basic industry-specific research to identify these opportunities can be given special attention in academic communities. In addition, it is recommended that this model be implemented on Fairtrade products.

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Appendix A. Purchasing Model Variables' Results in Several GA Implementations

Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7
U111	0	87	0	0	0	509	0	U545	0	0	868	0	1202	0	2007	Z327	0	0	1	0	0	0	0
U112	907	0	0	0	1299	170	0	U546	4022	4052	0	0	0	505	3857	Z328	0	0	0	0	0	0	1
U113	0	0	0	0	0	0	0	U547	4155	0	0	0	2345	0	2059	Z331	0	1	0	0	1	1	0
U114	0	0	577	0	0	1277	873	U548	0	0	3643	3773	523	0	3060	Z332	1	0	1	0	0	0	0
U115	0	1185	0	0	0	0	402	Q11	0	697	463	0	764	162	561	Z333	0	1	0	0	1	1	0
U116	0	624	0	631	0	0	591	Q12	0	1320	1110	0	0	0	0	Z334	0	0	1	0	0	0	0
U117	774	479	1300	0	1080	854	0	Q13	1222	477	0	0	0	0	919	Z335	0	0	1	1	1	0	0
U118	0	0	1162	964	0	567	960	Q14	583	804	0	1446	338	0	0	Z336	0	1	0	0	0	0	1
U121	0	101	0	2335	0	0	0	Q15	0	0	305	808	662	0	1144	Z337	1	1	0	1	1	0	0
U122	451	0	133	0	0	0	1044	Q16	710	0	648	447	1441	480	0	Z338	0	1	0	0	0	0	0
U123	1572	0	0	78	0	0	0	Q17	0	0	0	966	0	0	0	Z341	1	0	1	1	1	1	0
U124	0	0	0	1988	0	0	2214	Q18	342	0	0	0	0	0	0	Z342	1	1	0	1	0	0	0
U125	0	0	0	1288	1313	0	0	Q21	1227	0	374	0	0	1770	2068	Z343	0	1	1	0	0	1	1
U126	1346	0	2509	0	0	0	0	Q22	1561	2592	0	0	0	1183	0	Z344	0	1	1	1	1	0	1
U127	729	1539	0	0	0	0	1384	Q23	1008	839	1532	0	0	0	0	Z345	0	0	0	1	0	0	0
U128	0	0	956	1115	0	0	0	Q24	0	0	2600	0	0	753	0	Z346	1	0	1	1	0	0	0
U131	0	0	0	0	472	0	0	Q25	0	448	2600	0	0	390	0	Z347	0	0	0	1	0	0	0
U132	0	175	1983	0	953	0	0	Q26	0	0	947	0	0	0	1324	Z348	1	1	1	1	1	0	0
U133	0	0	0	0	0	0	0	Q27	0	0	0	0	1929	255	1262	Z411	0	0	1	1	0	0	0
U134	0	1179	0	0	928	395	0	Q28	1041	1537	0	278	1845	0	1287	Z412	1	0	1	0	0	0	1
U135	322	756	2010	809	0	0	0	Q31	0	0	1182	421	0	0	767	Z413	0	1	1	0	1	0	1
U136	0	0	447	0	0	813	560	Q32	0	1208	0	0	0	969	955	Z414	0	0	0	0	0	0	1
U137	370	0	0	1782	0	0	0	Q33	0	531	2400	0	317	0	0	Z415	0	0	1	1	1	0	0
U138	0	0	1714	2020	1027	57	0	Q34	1007	728	0	0	950	1274	0	Z416	0	1	0	0	0	1	0
U141	0	0	0	0	1992	1806	447	Q35	1514	863	0	797	0	390	1454	Z417	1	0	0	0	0	1	1
U142	0	1794	0	0	3662	0	3394	Q36	2070	470	0	1131	0	0	0	Z418	1	0	0	0	0	0	0
U143	3894	1963	3096	1239	2408	0	3626	Q37	0	0	0	0	0	435	0	Z421	1	0	0	0	0	0	0
U144	4311	1666	2558	0	1652	383	0	Q38	0	0	426	0	374	2104	0	Z422	1	0	0	0	0	0	0
U145	0	951	0	0	3077	3629	2805	Q41	0	1762	0	2546	0	0	3817	Z423	0	0	0	1	0	1	0
U146	0	0	0	0	4374	1789	0	Q42	3472	3165	3342	0	2349	0	0	Z424	1	1	0	0	0	0	1
U147	1484	1035	0	0	0	4148	902	Q43	0	0	0	4319	0	1104	1882	Z425	1	1	0	0	0	0	0
U148	0	0	0	0	1309	0	0	Q44	0	2891	0	3425	0	0	4360	Z426	0	0	0	0	1	0	0
U211	0	416	0	0	0	0	640	Q45	1357	1672	0	1765	0	0	669	Z427	0	1	0	1	1	0	0
U212	0	0	0	166	0	80	1066	Q46	58	0	448	1991	0	1061	0	Z428	1	1	0	0	0	0	1
U213	0	488	0	1680	889	0	0	Q47	0	3851	1740	2718	3295	1486	0	Z431	1	1	0	1	0	1	0
U214	636	0	636	0	748	0	972	Q48	3099	1792	0	0	0	2953	2339	Z432	0	0	0	0	0	1	0
U215	0	854	0	411	780	0	0	Y11	0	1	1	0	1	1	1	Z433	0	0	0	1	0	1	1
U216	0	809	0	363	0	0	0	Y12	0	1	1	0	0	0	0	Z434	0	0	0	1	0	0	0
U217	0	603	0	0	0	0	0	Y13	1	1	0	0	0	1	1	Z435	0	0	0	0	0	1	0

Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7
U218	0	0	0	0	0	0	0	Y14	1	1	0	1	1	1	0	Z436	0	1	1	1	1	0	0
U221	0	0	0	427	1604	991	0	Y15	0	0	1	1	1	0	1	Z437	1	1	0	1	0	0	1
U222	0	0	2227	887	0	0	0	Y16	1	0	1	1	1	1	0	Z438	1	0	0	1	1	0	1
U223	0	465	0	619	808	1321	477	Y17	0	0	0	1	0	0	0	Z441	0	0	0	0	1	0	0
U224	896	1810	909	288	0	0	0	Y18	1	0	0	0	0	0	0	Z442	0	0	1	1	0	0	0
U225	0	1662	0	1473	1452	0	0	Y21	1	0	1	0	0	1	1	Z443	1	0	1	1	1	0	0
U226	1535	0	0	1884	0	0	0	Y22	1	1	0	0	0	1	0	Z444	1	1	0	0	1	1	0
U227	0	0	0	0	0	0	0	Y23	1	1	1	0	0	0	0	Z445	1	0	1	1	1	1	1
U228	510	0	1280	843	558	1020	0	Y24	0	0	1	0	0	1	0	Z446	0	1	1	1	1	0	1
U231	0	0	0	0	0	0	0	Y25	0	1	1	0	0	1	0	Z447	0	0	0	1	0	0	0
U232	895	524	0	2162	0	0	1204	Y26	0	0	1	0	0	0	1	Z448	1	1	0	0	1	0	0
U233	2160	0	0	1639	0	92	742	Y27	0	0	0	0	1	1	1	Z511	0	0	0	0	1	1	0
U234	1153	254	0	0	0	110	2162	Y28	1	1	0	1	1	0	1	Z512	0	0	0	0	0	1	1
U235	0	0	0	0	0	0	711	Y31	0	0	1	1	0	0	1	Z513	1	1	0	0	1	0	1
U236	0	0	0	0	886	0	0	Y32	0	1	1	0	0	1	1	Z514	1	1	1	0	1	1	0
U237	0	0	0	0	0	1726	0	Y33	0	1	1	0	1	0	0	Z515	1	0	1	1	0	1	0
U238	0	0	0	0	0	0	0	Y34	1	1	0	0	1	1	0	Z516	0	0	1	0	0	1	0
U241	0	3171	2165	1803	1294	2390	0	Y35	1	1	0	1	0	1	1	Z517	0	0	0	0	0	0	1
U242	0	0	0	0	0	1672	2607	Y36	1	1	0	1	0	0	0	Z518	1	0	0	0	0	1	0
U243	1264	1247	0	0	0	1489	0	Y37	0	0	0	0	0	1	0	Z521	0	0	1	0	0	0	0
U244	1522	0	307	239	0	2192	0	Y38	0	0	1	0	1	1	0	Z522	0	0	1	1	1	1	0
U245	2787	3624	3699	1706	0	0	0	Y41	0	1	0	1	0	0	1	Z523	0	1	1	1	0	0	0
U246	0	0	0	0	0	2657	932	Y42	1	1	1	0	1	0	0	Z524	0	0	0	0	1	1	0
U247	0	762	3989	2251	0	0	2680	Y43	0	0	0	1	0	1	1	Z525	1	0	0	0	0	0	1
U248	0	0	0	0	0	2468	0	Y44	0	1	0	1	0	0	1	Z526	0	1	0	1	0	0	1
U311	1202	0	0	839	0	0	0	Y45	1	1	0	1	0	0	1	Z527	1	0	1	0	0	1	0
U312	0	0	0	1153	0	0	0	Y46	1	0	1	1	0	1	0	Z528	0	0	1	1	0	1	0
U313	0	0	1119	0	0	1654	0	Y47	0	1	1	1	1	1	0	Z531	1	1	1	0	1	1	1
U314	0	0	0	836	0	0	0	Y48	1	1	0	0	0	1	1	Z532	0	1	1	0	1	0	0
U315	1243	0	682	0	0	967	495	D1	1	2	3	0	0	0	3	Z533	0	0	0	0	1	1	0
U316	732	0	0	0	0	0	850	D2	2	3	2	1	0	3	3	Z534	0	0	0	1	1	1	0
U317	0	0	0	115	0	0	0	D3	2	0	3	2	4	0	3	Z535	1	1	0	0	1	1	0
U318	0	955	0	0	960	0	0	D4	3	4	1	2	2	5	0	Z536	1	0	1	0	1	1	0
U321	0	2660	0	0	1154	0	693	D5	0	2	1	3	4	0	2	Z537	0	1	1	0	0	0	1
U322	0	0	0	0	1905	0	1598	D6	0	0	0	0	0	0	0	Z538	1	0	0	0	0	0	1
U323	0	0	0	0	1772	0	2103	D7	0	0	0	0	0	0	0	Z541	1	1	0	1	0	1	1
U324	0	0	0	244	0	358	0	D8	0	0	0	0	0	0	0	Z542	1	0	1	1	0	1	0
U325	1142	0	0	0	0	2371	2497	D9	0	0	0	0	0	0	0	Z543	0	1	1	0	1	0	0
U326	0	0	0	0	1301	2909	0	D10	0	0	0	0	0	1	0	Z544	0	0	0	0	1	1	0
U327	0	0	1133	0	0	0	0	Z111	0	1	0	0	0	1	0	Z545	0	0	1	0	1	0	1
U328	0	0	0	0	0	0	300	Z112	1	0	0	0	1	1	0	Z546	1	1	0	0	0	1	1

Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7
U331	0	677	0	0	591	1788	0	Z113	0	0	0	0	0	0	0	Z547	1	0	0	0	1	0	1
U332	1270	0	445	0	0	0	0	Z114	0	0	1	0	0	1	1	Z548	0	0	1	1	1	0	1
U333	0	1629	0	0	1129	1572	0	Z115	0	1	0	0	0	0	1	I11	0	0	0	0	0	0	0
U334	0	0	2170	0	0	0	0	Z116	0	1	0	1	0	0	1	I12	0	0	0	0	0	0	0
U335	0	0	251	557	1011	0	0	Z117	1	1	1	0	1	1	0	I13	0	0	0	0	0	0	0
U336	0	253	0	0	0	0	1603	Z118	0	0	1	1	0	1	1	I14	0	0	0	0	0	0	0
U337	562	385	0	130	2161	0	0	Z121	0	1	0	1	0	0	0	I15	0	0	0	0	0	0	0
U338	0	2160	0	0	0	0	0	Z122	1	0	1	0	0	0	1	I16	0	0	0	0	0	0	0
U341	3429	0	3664	1093	421	1197	0	Z123	1	0	0	1	0	0	0	I17	0	0	0	0	0	0	0
U342	2075	1043	0	1191	0	0	0	Z124	0	0	0	1	0	0	1	I18	0	0	0	0	0	0	0
U343	0	1915	1148	0	0	3650	730	Z125	0	0	0	1	1	0	0	I21	0	0	0	0	0	0	0
U344	0	1924	3859	2939	2241	0	2241	Z126	1	0	1	0	0	0	0	I22	0	0	0	0	0	0	0
U345	0	0	0	2008	0	0	0	Z127	1	1	0	0	0	0	1	I23	0	0	0	0	0	0	0
U346	1918	0	3165	2841	0	0	0	Z128	0	0	1	1	0	0	0	I24	0	0	0	0	0	0	0
U347	0	0	0	320	0	0	0	Z131	0	0	0	0	1	0	0	I25	0	0	0	0	0	0	0
U348	1396	1122	2335	1628	1099	0	0	Z132	0	1	1	0	1	0	0	I26	0	0	0	0	0	0	0
U411	0	0	738	361	0	0	0	Z133	0	0	0	0	0	0	0	I27	0	0	0	0	0	0	0
U412	413	0	261	0	0	0	124	Z134	0	1	0	0	1	1	0	I28	0	0	0	0	0	0	0
U413	0	444	561	0	212	0	212	Z135	1	1	1	1	0	0	0	I31	0	0	0	0	0	0	0
U414	0	0	0	0	0	0	437	Z136	0	0	1	0	0	1	1	I32	0	0	0	0	0	0	0
U415	0	0	245	467	598	0	0	Z137	1	0	0	1	0	0	0	I33	0	0	0	0	0	0	0
U416	0	9	0	0	0	215	0	Z138	0	0	1	1	1	1	0	I34	0	0	0	0	0	0	0
U417	309	0	0	0	0	226	409	Z141	0	0	0	0	1	1	1	I35	0	0	0	0	0	0	0
U418	182	0	0	0	0	0	0	Z142	0	1	0	0	1	0	1	I36	0	0	0	0	0	0	0
U421	1537	0	0	0	0	0	0	Z143	1	1	1	1	1	0	1	I37	0	0	0	0	0	0	0
U422	631	0	0	0	0	0	0	Z144	1	1	1	0	1	1	0	I38	0	0	0	0	0	0	0
U423	0	0	0	636	0	1262	0	Z145	0	1	0	0	1	1	1	I41	0	0	0	0	0	0	0
U424	1624	710	0	0	0	0	306	Z146	0	0	0	0	1	1	0	I42	0	0	0	0	0	0	0
U425	989	650	0	0	0	0	0	Z147	1	1	0	0	0	1	1	I43	0	0	0	0	0	0	0
U426	0	0	0	0	1578	0	0	Z148	0	0	0	0	1	0	0	I44	0	0	0	0	0	0	0
U427	0	1104	0	2335	713	0	0	Z211	0	1	0	0	0	0	1	I45	0	0	0	0	0	0	0
U428	849	872	0	0	0	0	816	Z212	0	0	0	1	0	1	1	I46	0	0	0	0	0	0	0
U431	1350	865	0	1738	0	241	0	Z213	0	1	0	1	1	0	0	I47	0	0	0	0	0	0	0
U432	0	0	0	0	0	1197	0	Z214	1	0	1	0	1	0	1	I48	0	0	0	0	0	0	0
U433	0	0	0	520	0	188	1415	Z215	0	1	0	1	1	0	0	G11	0	1	1	1	1	0	1
U434	0	0	0	1625	0	0	0	Z216	0	1	0	1	0	0	0	G12	1	1	1	0	1	1	1
U435	0	0	0	0	0	1621	0	Z217	0	1	0	0	0	0	0	G13	1	0	1	1	1	1	0
U436	0	1446	1314	1030	680	0	0	Z218	0	0	0	0	0	0	0	G14	0	0	0	1	1	0	0
U437	1227	509	0	248	0	0	762	Z221	0	0	0	1	1	1	0	G15	1	1	0	0	0	1	1
U438	1014	0	0	140	761	0	455	Z222	0	0	1	1	0	0	0	G16	0	0	0	1	1	1	0

Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Variable Name	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7
U441	0	0	0	0	2054	0	0	Z223	0	1	0	1	1	1	1	G17	1	0	0	1	0	1	0
U442	0	0	1514	620	0	0	0	Z224	1	1	1	1	0	0	0	G18	1	1	0	1	1	1	0
U443	1080	0	1744	685	1645	0	0	Z225	0	1	0	1	1	0	0	G21	0	1	1	1	0	1	0
U444	770	135	0	0	1282	1456	0	Z226	1	0	0	1	0	0	0	G22	1	0	0	1	1	0	1
U445	2097	0	1673	763	1964	2610	757	Z227	0	0	0	0	0	0	0	G23	1	0	0	1	1	0	1
U446	0	1952	2389	1168	1633	0	1224	Z228	1	0	1	1	1	1	0	G24	0	0	1	0	0	1	0
U447	0	0	0	351	0	0	0	Z231	0	0	0	0	0	0	0	G25	1	0	0	1	1	0	0
U448	914	2476	0	0	2467	0	0	Z232	1	1	0	1	0	0	1	G26	1	0	1	0	1	1	0
U511	0	0	0	0	436	528	0	Z233	1	0	0	1	0	1	1	G27	0	1	0	0	1	0	1
U512	0	0	0	0	0	1070	131	Z234	1	1	0	0	0	1	1	G28	0	1	1	1	1	0	0
U513	460	271	0	0	579	0	549	Z235	0	0	0	0	0	0	1	G31	1	1	0	1	0	1	0
U514	1064	1481	1067	0	1194	877	0	Z236	0	0	0	0	1	0	0	G32	0	0	0	1	0	0	1
U515	798	0	825	356	0	1073	0	Z237	0	0	0	0	0	1	0	G33	0	1	1	1	1	1	1
U516	0	0	924	0	0	967	0	Z238	0	0	0	0	0	0	0	G34	1	1	0	1	0	0	1
U517	0	0	0	0	0	0	671	Z241	0	1	1	1	1	1	0	G35	0	0	0	0	0	1	0
U518	435	0	0	0	0	393	0	Z242	0	0	0	0	0	1	1	G36	1	1	0	0	0	1	0
U521	0	0	2431	0	0	0	0	Z243	1	1	0	0	0	1	0	G37	1	1	1	0	1	1	0
U522	0	0	272	1753	743	1458	0	Z244	1	0	1	1	0	1	0	G38	0	1	1	0	0	1	0
U523	0	1279	1052	1252	0	0	0	Z245	1	1	1	1	0	0	0	G41	1	1	1	0	0	0	1
U524	0	0	0	0	2520	1408	0	Z246	0	0	0	0	0	1	1	G42	0	0	1	1	0	1	0
U525	631	0	0	0	0	0	267	Z247	0	1	1	1	0	0	1	G43	0	0	1	1	1	0	0
U526	0	2879	0	1000	0	0	1556	Z248	0	0	0	0	0	1	0	G44	0	0	1	0	0	0	1
U527	1912	0	1504	0	0	2389	0	Z311	1	0	0	1	0	0	0	G45	1	0	0	1	0	0	1
U528	0	0	169	156	0	1386	0	Z312	0	0	0	1	0	0	0	G46	0	1	1	1	1	0	1
U531	808	619	975	0	1098	135	1392	Z313	0	0	1	0	0	1	0	G47	0	0	0	0	1	0	1
U532	0	250	1765	0	1210	0	0	Z314	0	0	0	1	0	0	0	G48	1	0	0	0	1	0	1
U533	0	0	0	0	715	307	0	Z315	1	0	1	0	0	1	1	G51	1	0	1	1	1	1	1
U534	0	0	0	533	283	385	0	Z316	1	0	0	0	0	0	1	G52	1	0	0	0	0	0	0
U535	329	547	0	0	1151	153	0	Z317	0	0	0	1	0	0	0	G53	0	0	0	0	0	1	0
U536	91	0	402	0	593	1347	0	Z318	0	1	0	0	1	0	0	G54	1	0	1	1	1	1	0
U537	0	1270	1550	0	0	0	1397	Z321	0	1	0	0	1	0	1	G55	1	1	1	0	0	1	1
U538	1151	0	0	0	0	0	1705	Z322	0	0	0	0	1	0	1	G56	1	1	0	0	0	1	1
U541	2332	811	0	318	0	373	1499	Z323	0	0	0	0	1	0	1	G57	0	1	1	1	0	1	1
U542	462	0	1152	4189	0	4333	0	Z324	0	0	0	1	0	1	0	G58	1	1	1	0	0	1	0
U543	0	1116	251	0	2200	0	0	Z325	1	0	0	0	0	1	1								
U544	0	0	0	0	1428	2568	0	Z326	0	0	0	0	1	1	0								

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